

found, those of  $x_2, y_2, z_2$ , and their first differential co-efficients, are readily derived, the equations for determining them being linear.

By means of the first approximate values of the unknown quantities, the second order of approximation is proceeded with so as to include differential co-efficients of the third order and the more important aberration terms. The third approximation includes differential co-efficients of the fourth order, and some small additional aberration terms. These approximations are so conducted that the quantities obtained are *corrections* to the first obtained values, and it is consequently not necessary to calculate with seven-figure logarithms.

The values of  $x_2, y_2, z_2, \frac{dx_2}{dt}, \frac{dy_2}{dt}, \frac{dz_2}{dt}$ , being thus obtained as accurately as possible, the elements of the orbit are readily derived by known formulæ. As the observed right ascension and north polar distance were not corrected into latitudes and longitudes, the elements are by this calculation referred to a plane through the sun's centre parallel to the earth's equator in a given position. By a simple computation they may be transferred to the plane of the ecliptic. But the original form is the most convenient for obtaining geocentric co-ordinates in terms of the eccentric anomaly, for the purpose of calculating an ephemeris; and also for deriving equations of condition by which the elements may be corrected by future observations. The method of doing this the author proposes to describe at another opportunity.

---

### *A brief Notice of the Imperial Observatory of Poulkova.*

By the Astronomer Royal.\*

The Observatory of Poulkova was built on the plans furnished by its director, M. Struve; the instruments are, for the most part, constructed according to his special instructions. The peculiar scope of this noble establishment is *sidereal* astronomy in its widest sense; and Mr. Airy strongly expresses his admiration of the definiteness of the purpose which M. Struve had in his mind, and of the thorough manner in which it has been carried into effect. He says that "no astronomer can feel himself perfectly acquainted with modern astronomy in its most highly cultivated form, whether as regards the personal establishment, the preparation of the buildings, the selection or construction of the instruments, or the delicacy of using them, who has not well studied the Observatory of Poulkova. To this excellence many antecedent circumstances have

\* The Astronomer Royal visited Poulkova last summer, and gave orally an account of the Observatory at the meeting of the Society in November, the substance of which was communicated in a letter to Professor Schumacher, and printed in the *Astronomische Nachrichten*.

materially contributed : the first of these is the personal character of M. Struve ; his mature experience obtained before the intention of building the new observatory had been formed ; his vigour in arranging the plans on a large scale, and in superintending constructions even to the minutest point, and his perseverance and skill in arranging the subsequent proceedings of the observatory." The liberality of the Emperor, the freedom of choice as to site, instruments, &c., have been admirably employed by the director. The character of the buildings, in addition to their perfect suitability to their design, is that of splendour without extravagance. The foundations are most carefully laid, and solid beyond any former example.\*

The large Equatoreal, by Merz and Mahler, is the instrument which has principally extended the fame of the Poulkova Observatory. The optical part is doubtless admirable, though, perhaps, more control over the adjustment of the object-glass would be desirable ; but Mr. Airy was far from satisfied with the rest of the instrument. It did not obey its slow motions in right ascension and declination with promptitude or accuracy, and the clock movement was deficient in power. In short, though in the delicate and experienced hands of M. Otto Struve the telescope is made to yield the utmost of its powers, Mr. Airy does not consider the instrument, as he saw it, a good specimen of mechanism.

The Heliometer, by the same artists, met with much greater admiration ; and, indeed, Mr. Airy seems to have been very much impressed with the beauty and excellence of all the other instruments. He goes so far as to say that he considers the meridional observations at Poulkova to be greatly superior to those of any other observatory with which he is acquainted. The Transit and Vertical Circle of Ertel, the Meridian Circle and Prime Vertical Telescope of Repsold, are praised, with some critical remarks, but no serious drawback. Some doubt is expressed whether the Prime Vertical Telescope would, in other hands than those of M. Struve himself, give quite such marvellous results as he obtains from it : still, in Mr. Airy's judgment, a prime vertical telescope is far superior to any zenith sector yet contrived for the investigation of aberration, parallax, &c., or small differences of latitude ; and he considers the Poulkova results as leaving all competition far behind.

Mr. Airy " had the pleasure of witnessing complete observations made by M. Struve with the Prime Vertical Telescope, and pays the tribute of his admiration to the caution, the delicacy, the steadily waiting till the proper time, the promptitude at the proper time, which distinguish the director's mode of observing."

The excellence of the levels attached to the instruments at Poulkova, and the successful precautions constantly practised there

\* The Observatory and its instruments may be well understood from the beautiful work published by M. Struve, *Description de l'Observatoire Astronomique Central de Poulkova*, St. Pétersbourg, 1845, 4to. with a volume of plates, which has been distributed most liberally among astronomers.

to avoid error in their use, are particularly noticed. The construction of the Standard Barometer is pronounced to be "admirable," and the noble Library\* considered "to be probably the most complete in the world in reference to its peculiar subjects."

---

*On the Transit Instrument at the Bombay Observatory.*

By Capt. Shortrede.

Captain Shortrede gives a short account of the instrument, its mounting, &c. before he became acquainted with it. Such mistakes as he relates can scarcely occur a second time, and therefore they may be passed over in silence.

When Capt. Shortrede visited the Bombay Observatory during his trigonometrical operations, he learned that the instrument was considered incurably defective. A full consideration, however, led him to a different opinion; and as he is himself a workman, and from his former connexion with the Mint as assistant-engineer, had great facilities for procuring the best assistance which the country afforded, he undertook the re-erection of the instrument, which, his his own services being gratuitous, would not exceed 300 rupees. This offer being communicated to the Governor, the sum specified was readily advanced.

The stone pillars are two feet square: the upper part of one had been greatly split and shaken by unskilful perforations; and Capt. Shortrede directed the upper 15 inches of each to be taken off. These he replaced by two blocks of Puna stone, which are 18 inches square at bottom, sloping to 12 inches square at top. This size seemed sufficient for steadiness, and was as large as could well be procured at Puna or transported to Bombay. Due care was taken to attach the blocks perfectly to the piers.

The new Y plates were of bell-metal, cast at the Mint, and well and truly worked; particular care was taken that the plate bore truly on the stone near the screw-holes.

The pivots of the axis are supported throughout their length; the motions for every adjustment were found free and without shake. Instead of the usual Y, Capt. Shortrede adopted a collar bearing, which he intended should exactly fit the pivots. The workman, however, made them somewhat large, and, as he finished them by grinding, not quite true. Having no time to get new collars made, Capt. Shortrede had a groove cut out at the bottom of the bearing and at the top of the covering piece, in each of which a slip of wash-leather was secured by lac-varnish. These

\* A Catalogue of this Library has been recently published, *Librorum in Bibliothecâ Speculæ Pulcovensis contentorum Catalogus Systematicus*, Petropoli Typis Acad. Scient. 1845, 8vo.